

SECTION 511 THRU 519 — RESERVED

SECTION 520 — PLAIN AND REINFORCED
PORTLAND CEMENT CONCRETE PAVEMENTS

520.01 DESCRIPTION. This work shall consist of constructing plain and reinforced portland cement concrete pavements as specified in the Contract Documents or as directed by the Engineer.

520.02 MATERIALS.

Portland Cement Concrete and Related Products	902
Reinforcement Steel	908
Joint Materials	911
Portland Cement Concrete Plant	915.03
Epoxy Coating for Reinforcement	917.02

Reinforcement, including load transfer assemblies, tie bars, deformed steel bars and longitudinal tie devices shall conform to Section 908 and shall be epoxy coated.

520.03 CONSTRUCTION. At least 30 days prior to the start of paving operations, the Contractor shall submit for approval, a proposed paving plan, including production plants, location of plants with respect to project site, equipment, proposed material sources, and whether the fixed or slip form method shall be used.

The Contractor shall protect the pavement against damage from all causes. Any part of the pavement that is damaged shall be repaired or replaced by the Contractor at no additional cost to the Administration.

Concrete shall be mixed, placed, or finished when natural light is sufficient, or an adequate artificial lighting system approved by the Engineer is operated.

520.03.01 Equipment. All equipment, including the production plant and paving equipment, shall be approved by the Engineer. The plant, including central mixers, batching plant, truck mixers, and hauling equipment shall conform to Section 915. The plant shall be ready for inspection by the Engineer at least 48 hours prior to the start of construction operations. Paving equipment shall be on the job site, ready for inspection, at least 24 hours prior to the start of construction operations.

Slip form pavers shall be self-propelled on crawler tracks, and no other tractive force other than that which is provided and controlled by the paving machine itself shall be applied. The paver shall be capable of being automatically controlled for both alignment and grade.

The equipment and methods used shall provide a means of obtaining the prescribed weights within the allowable tolerances to achieve the consistency specified with a minimum amount of water to achieve proper placement of the mixture in a condition of maximum density with no segregation, and to finish and cure the pavement as specified herein.

520.03.02 Weather Restrictions.

- (a) **Temperature and Surface Conditions.** Concrete placement shall begin only when the ambient air and surface temperature is at least 40 F and rising and discontinued anytime the temperature falls below 40 F. These requirements may be waived for incidental concrete construction. Placing concrete on a frozen base is prohibited.
- (b) **Precipitation.** The Contractor shall have on hand sufficient material, approved by the Engineer, to cover freshly placed concrete as protection against precipitation.
- (c) **Wind.** Concrete shall not be placed when the Engineer determines that the wind would have a detrimental effect on the work.

When weather conditions differ from these limits, material en route from the plant to the job site may be used at the Contractor's risk.

If placement of the material is stopped by the Engineer for any other reason, all material en route shall be disposed of at no additional cost to the Administration.

520.03.03 Foundation. Prior to the installation of fixed forms or the use of slip forms on the foundation, the foundation shall be constructed as specified in the Contract Documents and approved by the Engineer. The total width of the foundation shall be the width of the pavement to be placed, and extend a minimum of 4 in. outside the base of the fixed form or the outermost edge of the slip form paver track or wheel. No additional payment will be made for the extended width.

520.03.04 Forms. Side forms shall be made of steel not less than 7/32 in. thick with a depth equal to the edge thickness of the pavement. Built up forms and warped forms are prohibited. Forms shall be of sufficient strength to resist all loads applied in the paving process. Forms

shall have a base equal to their height and a flat flanged tread or top surface not less than 2 in. wide. Forms shall be a minimum of 10 ft long except for installation along curves with a radius of less than 200 ft. When the curve radius is less than 200 ft, the forms shall be a maximum of 6 ft long or the forms shall be curved. Stake sockets to accommodate a 1 in. diameter steel stake shall be provided at the minimum rate of three in each section of the form except forms less than 10 ft long shall have at least two in each section.

Forms for keyways shall be rigidly fastened to the road form. Holes shall be provided through both forms and keyways to accommodate tie bars or dowels that may be required.

The forms shall be constructed to a tolerance that will ensure proper concrete placement. Tolerances for forms shall be 1/8 in. in 10 ft for the top, and 1/4 in. in 10 ft for the face. The forms shall provide means for locking the ends of abutting sections. Forms shall be clean and coated with an approved form release compound. Forms that are bent, deformed, or broken shall be removed or repaired as directed by the Engineer.

Grade controls shall be set at intervals not to exceed 25 ft. Forms shall be set a minimum of 400 ft prior to concrete placement. When the foundation has been disturbed after the forms have been set to the correct grade, it shall be corrected by the Contractor and approved by the Engineer. The Contractor shall check the alignment and grade for conformance with the Contract Documents. The foundation surface shall be checked using an approved device such as a scratchboard and correction shall be made by the Contractor before concrete placement.

Wooden forms may be approved for use in exceptional cases, such as on curves of very short radius or when a nonstandard length of straight form is required.

520.03.05 Slip Form Paving. Minimum width of slip form paving shall be 24 ft. If 24 ft width is impractical, written approval is required from the Deputy Chief Engineer, Construction. The total foundation width shall be graded using machine methods.

Grade controls shall be set by string lines at intervals not to exceed 25 ft. The foundation shall be constructed as specified in 520.03.03 and completed at least 1000 ft ahead of the paver before paving begins. Paving shall be stopped and a bulkhead construction joint installed whenever the paving machine comes to within 200 ft from the end of the approved foundation. When paving adjacent to an existing pavement, the paver shall have wheels with rubber tires or protective pads on crawler treads. A minimum clearance of 1 ft shall be maintained from the

outermost edge of the paver track or wheel to the edge of the existing pavement.

Slip forms shall be of a length sufficient to prevent slumping or sagging of the sides and top edges of the pavement slab. They shall be spaced and braced to a uniform and constant width and shall also be held vertical. Slip form equipment shall be capable of placing and securing embedded tie bars and keyways in proper position in the plastic concrete before the edge of the pavement slab is free of the slip form.

520.03.06 Reinforcement. Reinforcement shall be as specified in the Contract Documents. Reinforcement shall be kept clean and free from foreign material that may prevent proper bonding of the concrete.

- (a) Dowel bars at joints shall be installed on the approved foundation parallel to the foundation grade, sufficiently ahead of the placement of slab reinforcement and concrete. Each dowel bar shall be coated with a water insoluble lubricant acceptable to the Engineer. Dowel bars may be machine placed or set on chairs or prefabricated assemblies approved by the Engineer, providing proper alignment, depth and spacing.
- (b) Tie bars for longitudinal construction joints may be placed on chairs or machine placed so that upon the initial set of the concrete they shall be at proper alignment, depth and spacing, and shall be at right angles to the center line of the pavement. Chairs or machine placement devices shall be submitted to the Engineer for approval prior to use.
- (c) Fabric and mat reinforcement shall be furnished in flat sheets and shall be kept flat during placement. Reinforcement clearance shall be as specified in the Contract Documents.
- (d) When using slip forms, tied reinforcement bars or prefabricated mats may also be installed ahead of the placement of concrete by being supported on chairs set upon the underlying material. Reinforcement installed in this manner shall be in place for a distance ahead of the paver equal to at least 500 ft or a two hour run of the paver before any paving may begin. Paving shall be stopped and a bulkhead construction joint shall be installed whenever it comes to within 100 ft of the end of the steel placement. All reinforcement shall be adequately secured against displacement or movement.

520.03.07 Concrete Placement. Before concrete is placed on the foundation, the foundation shall be in a moist condition. In addition, if the concrete is exposed to the direct rays of the sun and the ambient

temperature is 70 F and rising, the forms and reinforcement shall be sprinkled with cool water just before placement of the concrete. Concrete shall be deposited on the foundation within the forms and rehandling shall be minimized.

Where concrete is to be placed adjoining a previously constructed lane of pavement, mechanical spreading and finishing equipment may be operated upon the existing lane of pavement only after the existing concrete has reached a compressive strength of 3000 psi in conformance with 902.10.03. Wheels that rest on the previously completed concrete shall be flat without flanges, and operated far enough from the edge of the slab to preclude spalling or damage. The tread of the wheels shall not be less than 3 in. wide. Sampling for control testing shall be done at the time of concrete placement and shall conform to 902.10.08.

The total depth of the slab shall be deposited in a single layer except as otherwise specified herein or approved by the Engineer. Two layer placement shall be used for pavement using bar mat or wire fabric reinforcement unless the Contractor demonstrates that the bar mat or wire fabric can be properly supported on devices approved by the Engineer.

Single Layer Placement. Reinforcement shall be set on chairs to maintain the stability and proper elevation of the reinforcement. Welding of reinforcement to the chairs in lieu of wire ties will be permitted, except for epoxy coated reinforcement, welding will be permitted only if the epoxy coating is applied after the welding. Any damage to epoxy coating shall be repaired as directed by the Engineer using materials specified in 917.02.

Two Layer Placement. The placing of concrete and bar mats or wire fabric reinforcement shall be a continuous operation. Concrete shall first be placed to the specified depth of reinforcement; the reinforcement shall then be immediately placed on the freshly deposited concrete. The second layer of concrete shall be placed immediately after the reinforcement is set in place.

520.03.08 Consolidation of Concrete.

Fixed Form Paving. Concrete shall be consolidated by means of immersion type vibrators. The vibrators shall advance with the paving equipment. Vibrator spacing, amplitude and depth shall ensure proper consolidation, clear reinforcement by 1/2 in., and shall be subject to approval by the Engineer. Special care shall be taken to ensure thorough consolidation along the faces of all forms and joint assemblies. Vibrators shall not come in contact with the side forms, joint assemblies, or underlying material. Excessive vibration which results in segregation shall be avoided.

Slip Form Paving. Concrete consolidation systems shall be incorporated in the paving equipment, and shall be submitted to the Engineer for approval.

520.03.09 Finishing.

Machine Finishing. The machine shall be equipped with two transverse screeds with provision for adjustment to ensure that the concrete is placed to the specified crown and grade. Following the transverse screeds, the concrete shall be screeded longitudinally. The width of the working face of the screeds shall not be less than 6 in. A chevron ("V" type) nonreciprocating finishing float or other type as approved by the Engineer shall be used. The float shall be suspended from a frame that does not ride directly on the forms. Following the finishing float, a scraping straightedge 10 ft long, equipped with a long handle shall be used to bring the pavement to the correct grade. When the finishing machine is operated over concrete which has partially set, provisions shall be made to prevent damage to the concrete by the machine wheels.

Hand Finishing. Where approved by the Engineer, hand finishing may be substituted for machine finishing. Rakes are prohibited for handling concrete.

520.03.10 Slab Surface and Thickness Checks.

Surface Check. After finishing, and before texturing of the concrete, the entire surface of the pavement shall be checked with a 10 ft long metal straightedge approved by the Engineer. The surface shall not deviate from a straight line or vertical curve transversely or longitudinally more than 1/8 in. in 10 ft.

Thickness Check. After the pavement is placed and before final acceptance, the thickness will be checked by the Engineer from cores cut by the Contractor. Coring shall be as specified in MSMT 552. Cores shall be spaced every 1000 ft for each lane unless otherwise specified or directed by the Engineer. Core holes shall be filled by the Contractor, at no additional cost to the Administration. When the thickness of pavement is deficient by more than 1 in., the full section of deficient pavement shall be removed and replaced by the Contractor at no additional cost to the Administration. Deficiencies up to 1 in. will be subject to reduced payment as specified in 520.04.

520.03.11 Texturing and Edging.

Texturing. Following concrete finishing and surface check, the roadway surface shall be given a textured finish using a texturing device which produces transverse corrugations 1/8 in. wide by 1/8 in. deep spaced

between 5/8 and 7/8 in. A 2 in. space shall be provided between passes of the texturing device and a 3 in. space provided between the last corrugation and the center line of all transverse joints. Texturing shall begin when the concrete surface is plastic enough to allow texturing to the depth specified but dry enough to prevent the plastic concrete from flowing back into the grooves being formed. Care shall be exercised to avoid overlaps and the tearing of the concrete in the texturing operation. Texturing on open sections shall be uniform for the full width of pavement. On closed sections, the last 12 in. of the roadway adjacent to the curb shall be left untextured to facilitate drainage. The completed textured finish shall be uniform in appearance.

Edging. After texturing the surface, and when the concrete has taken its initial set, transverse and longitudinal slabs shall be edged using a tool with a 1/4 in. radius.

520.03.12 Curing. Following texturing and edging, the concrete shall be cured for a minimum of 72 hours. Whenever the ambient air temperature falls below 40 F during the curing period, insulated blankets shall be used to maintain the concrete temperature above 40 F. Insulated blankets shall be used in addition to of the curing material. The Contractor shall provide a sufficient number of high/low thermometers to monitor the temperature of the concrete. The concrete shall be cured using one of the following methods:

- (a) **Liquid Membrane Forming Compound.** A liquid membrane forming compound used for curing shall conform to 902.07.03 and shall be applied to the surface as soon as the free water has disappeared from the surface. The compound shall be applied using an approved spraying machine having drive wheels that straddle the freshly placed concrete. Standby equipment shall be on site in the event of failure of the spraying machine. The spraying machine shall be equipped with an adequate wind guard and shall produce a fine spray of material that covers the surface with a uniform continuous film. The film shall be free of pin holes and other imperfections and shall be free of checks, cracks or peelings. Discontinuities in the film shall be corrected by application of an additional coat to the affected area within 30 minutes of the original coat. The compound shall be applied in two applications at a rate of 1 gal/200 ft² for both coats. Sprayed surfaces subjected to damaging rainfall within three hours after the second application shall be resprayed at no additional cost to the Administration.

Vertical surfaces of longitudinal and transverse joints shall be kept free of curing compound by the use of rope or other masking methods approved by the Engineer. Sprayed surfaces shall be

protected to prevent disruption of the continuity of the membrane. Application of compound by hand operated spraying equipment in irregular areas shall be as directed by the Engineer.

- (b) **Burlap Curing.** Burlap conforming to 902.07.01 shall be placed on the freshly placed concrete as soon as practical, without damaging the concrete. Burlap shall be overlapped to provide a double thickness on the entire surface. The burlap shall be saturated with water before placement and kept continuously wet during the curing period.
- (c) **Cotton Mat Curing.** Cotton mats conforming to 902.07.04 shall be placed on the freshly placed concrete as soon as practical, without damaging the concrete. Mats shall be saturated with water prior to placement and kept continuously wet during the curing period.
- (d) **Sheet Materials.** Sheet materials conforming to 902.07.02 shall be placed on the freshly placed concrete as soon as practical without damaging the concrete. Sheets shall be lapped at least 1 ft and extend outside the slab. Laps and edges shall be held securely in place to provide continuous contact of the sheet with the pavement surface.

520.03.13 Form Removal of Fixed Form Paving. Unless otherwise directed by the Engineer, forms shall remain until the concrete has set at least 12 hours. The sides of slabs that are not damaged shall be cured for the remaining 60 hours of the 72 hour curing period. Damaged or honeycombed areas shall be repaired and cured for an additional 72 hours.

520.03.14 Joints. Joints shall conform to the details specified in the Contract Documents, be perpendicular to the finished grade of the pavement and be sealed as specified in Section 523. Transverse expansion and contraction joints shall be straight and continuous from edge to edge of the pavement.

- (a) **Transverse Construction Joints.** Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for 30 minutes or longer. These joints shall be located at a planned joint except in case of equipment breakdown. When concrete placement cannot be continued, the transverse construction joint may be installed within the slab unit but not less than 10 ft from a planned transverse joint. Transverse construction joints shall be doweled as specified in the Contract Documents, and sawed as specified in (c)(1).

- (b) **Expansion Joints.** Expansion joints shall be formed by means of a preformed filler material conforming to 911.02. The filler shall be securely held in position by means of metal supports, as approved by the Engineer, which shall remain in the pavement. A removable metal channel cap bar shall be used to hold the parts of the joint in proper position and protect the filler from damage during concreting operations. The cap bar shall be removable without damage to the pavement to provide a space for sealing of the joint. Adjacent sections of filler shall be fitted tightly together, and shall extend across the full width of the paving lane to prevent entrance of concrete into the expansion space. Expansion joints shall be formed around structures and features that project through, into, or against the pavement, using joint filler of the type, thickness, and width specified in the Contract Documents or as directed by the Engineer.
- (c) **Contraction Joints.** Longitudinal and transverse contraction joints shall be constructed by sawing. If gravel aggregate is used, joints shall be tooled or formed by using an insert approved by the Engineer.
- (1) **Sawed Joints.** Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8 in. blade to the depth as specified in the Contract Documents. The time of sawing shall vary depending on existing and anticipated weather conditions and shall prevent uncontrolled cracking of the pavement. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without chipping, spalling, or tearing. Any membrane cured surface damaged during the sawing operations shall be resprayed as soon as the surface becomes dry. After completion of the curing period, the upper portion of the groove shall be widened by sawing to the width and depth specified. The saw blades may be single or gang type, with one or more blades mounted in tandem. Saw cutting into load transfer devices is prohibited. Immediately after the joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly flushed with water until all waste from sawing is removed from the joint.
- (2) **Insert Type Contraction Joints.** Insert type contraction joints shall be constructed by installing a preformed insert in the plastic concrete to form a weakened plane to induce cracking. The equipment for installing inserts shall be a machine equipped with a vibratory bar for cutting a groove in the plastic concrete for placement of the insert or for vibrating the insert into place at the prescribed joint location.

Installation of the insert shall be to the required depth throughout the full width of the paving lane. Vibration units shall be arranged so that the vibration will be uniformly distributed throughout the bar. The intensity of vibration shall be adjustable as necessary to form a groove of proper size for the filler or for forcing the insert into the plastic concrete and consolidating the concrete around the in place insert. For concrete placed by slip form pavers, the edges of the plastic concrete shall be supported to prevent slumping during the vibration and placement of inserts. The vibratory float shall be used following placement of the insert material in lieu of hand floating or troweling the finish. The insert shall be installed in the plastic concrete immediately following the final machine finishing with a maximum of two joint spacings between the finishing machine and the inserter. Additional straightedge and texturing operations shall be accomplished without disturbing the installed insert. Adjacent sections of the joint inserts within each slab unit shall be securely joined together, and the insert shall be thoroughly consolidated against the full depth of the insert. The insert shall be perpendicular to the finished grade of the pavement and shall be straight in alignment at the joint locations specified, with the top of the insert flush or not more than 1/8 in. below the pavement surface.

After the completion of the curing period, the top portion of fiberboard fillers or sawable preformed inserts shall be removed by sawing with a power saw as approved by the Engineer.

520.03.15 Pavement Profile. Refer to Pavement Surface Profile requirements specified in the Contract Documents.

520.03.16 Opening to Traffic. The pavement may be opened to vehicular traffic after having attained a compressive strength of 3000 psi. Tests of field samples shall conform to T 23.

520.04 MEASUREMENT AND PAYMENT. Plain and reinforced portland cement concrete pavements will be measured and paid for at the Contract unit price per square yard for the pertinent Portland Cement Concrete Pavement item. The square yard measurement will be computed on the basis of plan width and as-built length measured along the pavement center line. The payment will be full compensation for all concrete, forms, reinforcement steel, chairs, epoxy coating, finishing, curing, joints, joint construction, saw cutting, and joint sealing and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

520.04.01 Pavement Thickness Price Adjustment. Payment for areas that are accepted at a reduced price for deficient thickness will be adjusted by the factors shown in the following table. Deficiencies will be determined by procedures specified in 520.03.10. There will be no additional payment for excess thickness.

PAVEMENT THICKNESS PRICE ADJUSTMENT	
DEFICIENCY IN INCHES	PERCENT OF PAYMENT CONTRACT UNIT PRICE
0.00 to 0.20	100
0.21 to 0.30	80
0.31 to 0.40	72
0.41 to 0.50	68
0.51 to 0.75	57
0.76 to 1.00	50
Greater than 1.00 *See 520.03.10	0*

SECTION 521 — CONTINUOUSLY REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT

521.01 DESCRIPTION. This work shall consist of constructing continuously reinforced portland cement concrete pavement on a prepared subgrade as specified in the Contract Documents.

521.02 MATERIALS. Refer to 520.02 and the following:

Reinforcement. Reinforcement, including load transfer assemblies, tie bars, deformed steel bars and longitudinal tie devices shall conform to Section 908 and shall be epoxy coated. The Contractor shall select the type of reinforcement from one of the following:

- (a) Deformed steel bar mats conforming to 908.07. The longitudinal bars shall be No. 5, Grade 60, and the transverse bars shall be No. 4, Grade 60.
- (b) Loose deformed steel bars conforming to 908.01. The longitudinal bars shall be No. 5, Grade 60 with a minimum length